Scientific Return from Human Exploration of NEOs

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NEO Science from Human Exploration

Science Objectives: Big(ger) Picture

NEO come largely from main asteroid belt, some outer Solar System objects

Tie remotely-sensed NEO studies to *in-situ* studies…

Expand further to encompass understanding of NEO population properties

Study NEO population as (partly) representative of overall asteroid population

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Science Objectives for a Human-Tended Mission

- Local Scale: Optimizing Sample Return
  - Regolith properties: fine particulates, rubble/ pebbles
  - Surface *and* cores to internal compositional sample
- "Global" Scale: Geologic Context of the Asteroid
  - General cratering evidence in area
  - Structures, regional changes in properties (easily determined for structure)

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Precursor robotic exploration will provide:

- global remote sensing context for human exploration
- method of data relay for experiments left on asteroid
- interactive second body for NEO mass determination

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Specific science problems can be addressed with a human presence, expanding on all prior remote sensing

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Surface Structure of NEO

Macroscopic: cratering record, geologic structures,

Regional: characteristics of surface features at specific locations (ponds on Eros, Muses Sea on Itokawa)

Microscopic: Sample sizes (rubble, fine grains), particulate structure (smooth, sharp-edged fines)

ASTRONAUTS CAN QUICKLY IDENTIFY FORMATIONS OF STRUCTURAL INTEREST

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Surface and Internal Composition of NEO

General mineralogy and composition: mafic silicate (pyroxene, olivine composition), organics, metallics, …??

Presence of space weathering: same mechanism as affecting the moon (creation of $npFe^0$ in surface and near-surface regolith).

How deep does it go (core sampling to depth)?

Different levels of weathering with apparently different terrain?

Fresh (i.e., not exposed) samples?

ASTRONAUTS CAN MAKE CHOICES OPTIMIZING SAMPLE SELECTION

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Internal structure of NEO

Seismic shaking occurring on small bodies redistributing material on comparatively large scales (ponds on Eros, Muses Sea on Itokawa)

Internally solid bodies? Conglomerate rubble piles? Is this what has been predicted?

ASTRONAUTS CAN MAKE INFORMED DECISIONS ABOUT WHERE
TO PLACE LONG-TERM SCIENTIFIC EQUIPMENT, AND DEPLOY IT IN A TIMELY MANNER

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Astronaut Contribution to Science Exploration:

EVA sorties allow astronauts to select scientifically interesting locations to sample, study, record, place long-term equipment

Astronauts make scientifically-informed decisions about where and how to sample in order to optimize the science